COMPARATIVE GROWTH AND REPRODUCTION OF HEREFORD AND BRAHMAN CATTLE IN FLORIDA

J. R. Howes, J. F. Hentges, Jr., A. C. Warnick, and T. J. Cunha

The growth and reproductive pattern of beef cattle breeds which originated in Great Britain (*Bos taurus*) is well established for temperate climatic zones. Such information on Zebu (*Bos indicus*) cattle breeds is limited and mostly based on research in tropical climatic zones. These aspects of cattle production were reviewed by Rhoad (1955) and Cunha *et al.* (1963). This study was designed to provide data concerning the influence of controlled diets upon the growth and reproductive performance of Hereford (*Bos taurus* origin) and Brahman (*Bos indicus* origin) cattle in the Florida environment, which is intermediate to that in which both breeds originated. Two levels of protein intake were studied, one recommended and one prevalent on the average Florida ranch.

Methods

Three groups of registered purebred animals as representative as possible of the two breeds were employed in this study. Group I consisted of 24 yearling heifers, 12 of each breed; Group II included 24, 8-month-old weaned calves, 12 of each breed; and Group III was composed of 20 pregnant cows, 10 of each breed. Groups I and II were selected on the basis of age and weight. The cows in Group III were selected on the basis of production record and date of conception.

Half of the animals of each group were allocated at random by breed into two dietary treatments as follows: (1) a nutrient allowance recommended by the National Research Council (1950) for their respective ages and hereafter designated NRC and (2) the same nutrient allowances less 50 per cent of the crude protein intake, hereafter designated 50% NRC. All animals were grazed on grass pasture between May 15 and Oct. 15 for the summers of 1957, 1958, and 1959. The two dietary regimens were maintained during the summer by rotation of fertilized and unfertilized pastures in conjunction with monthly proximate analyses of forage from each pasture. As indicated in Table 1, the winter diets consisted of Pangolagrass hay with high or low protein supplements consist-

TABLE 1

Diets received by animals

Ingredient*	Crude Protein Approx. %	Summer		Winter	
		May 15–Oct. 15		Oct. 16–May 14	
		N.R.C.	50% N.R.C.	N.R.C.	50% N.R.C.
Fertilized pasture	12–14	X	—	—	—
Non-fertilized pasture	7–9	—	X	—	—
Pangolagrass hay	3–4	—	—	X	X
H.P.S.**	40	—	—	X	—
L.P.S.**	10	—	—	—	X

* These ingredients were fed in different ratios during the respective periods to meet the N.R.C. recommended nutrient allowances as suggested for cattle of various weights and conditions.

** H.P.S. and L.P.S. designate high and low protein supplements, respectively. These were composed of 41% cottonseed meal, ground yellow corn, steamed bonemeal, trace mineralized salt and a vitamin mix. The vitamin mixture was calculated to provide 15,000 I.U. vitamin A, 2,000 I.U. vitamin D, 22 I.U. vitamin E per day for each animal.

N.R.C. indicates diet recommended by National Research Council (1950) for the respective age and classification of animal.

TABLE 2

Reproduction data, groups I & II

Group	Breed	Diet	No.	Foll.[a]	C.L.[b]	Estrus[c]
I	Hereford	NRC	6	4.8 ± 0.70	8.8 ± 3.86	1.3 ± 0.07
	Hereford	50%	6	5.2 ± 0.84	10.0 ± 1.00	1.5 ± 0.35
	Brahman	NRC	6	6.7 ± 1.76	8.8 ± 1.73	0.2 — [d]
	Brahman	50%	6	6.5 ± 1.38	10.2 ± 1.70	0.5 ± 0.22
II	Hereford	NRC	6	12.0 ± 3.83	20.0 ± 3.20	0.8 ± 0.17
	Hereford	50%	6	10.0 ± 1.51	16.0 ± 2.59	1.0 _ [d]
	Brahman	NRC	6	25.0 ± 3.86	9.0 ± 1.76	1.2 ± 0.60
	Brahman	50%	6	29.0 ± 4.48	5.0 ± 1.03	1.3 ± 0.42

[a] Mean number large ovarian follicles for each animal in treatment over experimental period.

[b] Similar data for corpora lutea.

[c] Similar data for observed estrus.

[d] Too few data to calculate Standard Error.

ing basically of 41 per cent cottonseed meal and ground yellow corn.

In the spring of 1958, the two year-old heifers of Group I were exposed to bulls of their own breed during a 90-day period. The two bulls of each breed were exchanged every 14 days between the two dietary treatments to avoid confounding fertility of the bulls with the dietary treatments. Group II were similarly bred during the spring of 1959. The pregnant cows selected for Group III had been bred to bulls of their own breed in the previous spring of 1958.

During the breeding season and for the interval thereafter until pregnancy had been confirmed, all animals were rectally palpated at 14 day intervals. Rectal palpation was also carried out at various intervals subsequent to calving to determine the presence of corpora lutea and ovarian follicles.

At 28-day intervals, all adult animals were individually weighed. The calves were individually weighed at biweekly intervals until they were weaned at 8 months of age. By means of rectal palpation in conjunction with a record of observed signs of estrus and copulations, it was possible to obtain an accurate estimate of the age of puberty, the length of interval between first breeding and calving, the length of gestation period, the number of ovarian follicles and corpora lutea on each of the ovaries over a given period of time, and other data relating to reproductive efficiency.

Results

Growth data for the Herefords and Brahmans are presented in Figures 1a and 1b, respectively. All of the Hereford heifers calved when they were approximately 36 months of age. Brahmans on the low protein diet calved at approximately 34 months of age, and those receiving the NRC diet calved at an average age of 36 months. Only four out of each group of six Brahmans calved. Data for both lactating and non-lactating heifers are presented in Figure 1b. The growth of calves in the four breed-treatment lots of Group I is illustrated in Figure 2. The growth curves for Group II heifers are presented in Figures 3a and 3b respectively, and Figure 4a illustrates the body weights of the suckled dams for all four lots in Group III together with the growth of their calves (Figure 4b).

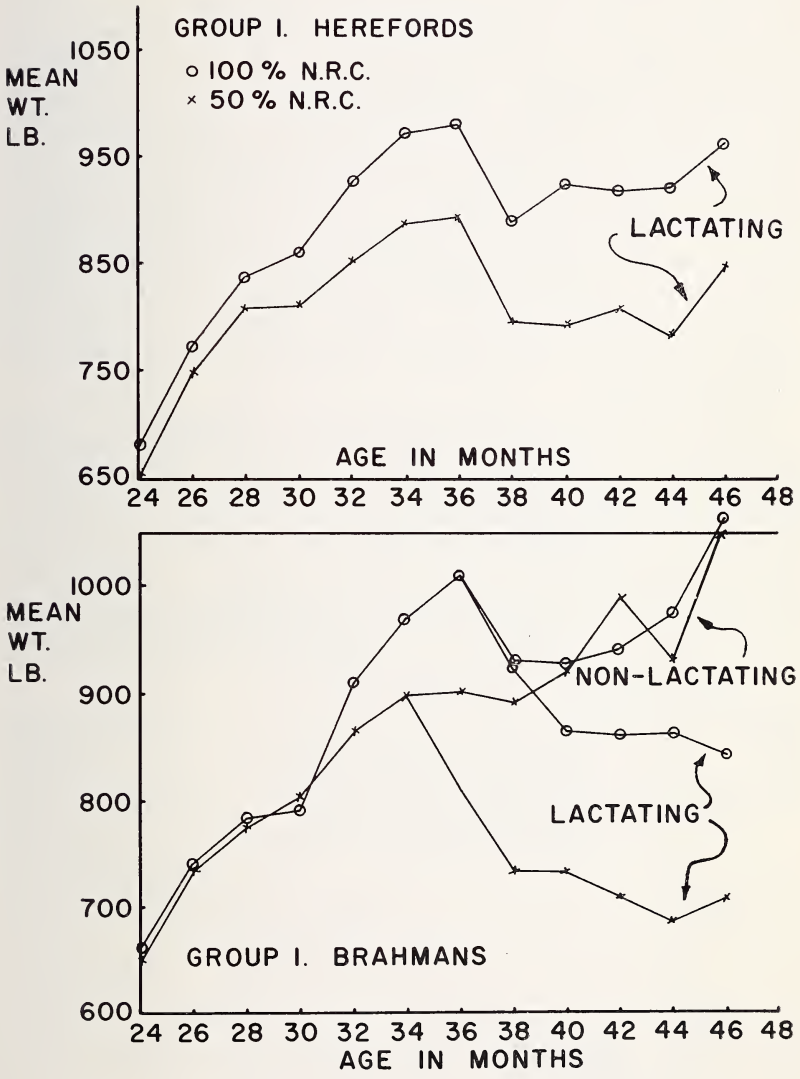

Fig. 1. Live weights of Herefords and Brahmans in Group I. Calving occurred at 34-36 months of age.

There were no significant differences between the growth patterns of the two breeds as demonstrated by analysis of variance of Group I and co-variance analysis of the combined data for Groups I and II. Analysis of the Group II data, however, did indicate that the Brahmans, which weighed less at the beginning of the experiment, were significantly heavier ($P < 0.01$) at 34 months of age. Analysis of covariance showed that the 50% NRC diet significantly depressed growth ($P < 0.01$) in both groups. Analysis of variance of the calf data in Figure 2 showed a significant difference in growth rate between both breeds and diets ($P < 0.01$). There were no significant differences between the data for breeds or diets in Figures 4a and b. A close inspection of these two graphs reveals the small amount of variability in the results for all four treatments.

Data relating to reproductive efficiency are presented for the three groups in Tables 2-6. Limited information with respect to duration of estrus for the two breeds is presented in Table 7. Because of limited digital data, none of the data presented in Table 2 were statistically analyzed. Only the first year interval between breeding and calving and the number of days for the first corpora lutea to appear after calving were subjected to analysis of variance in Table 3. No significant difference between

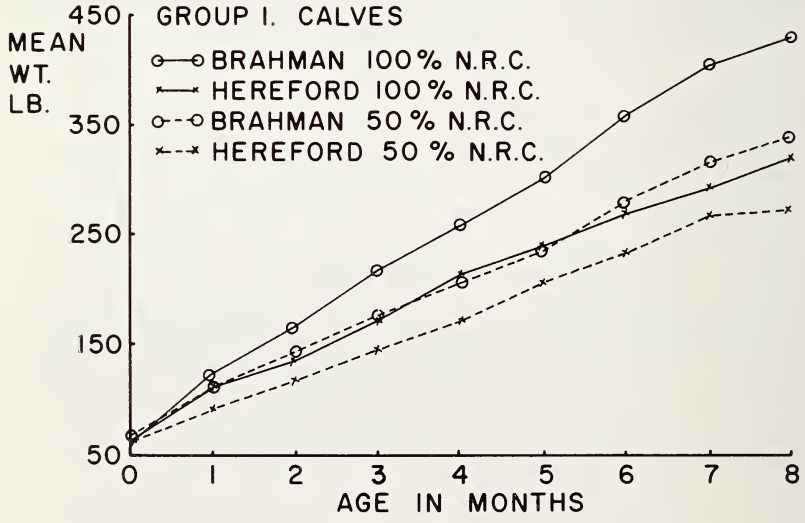

Fig. 2. Growth curves for calves of group I.

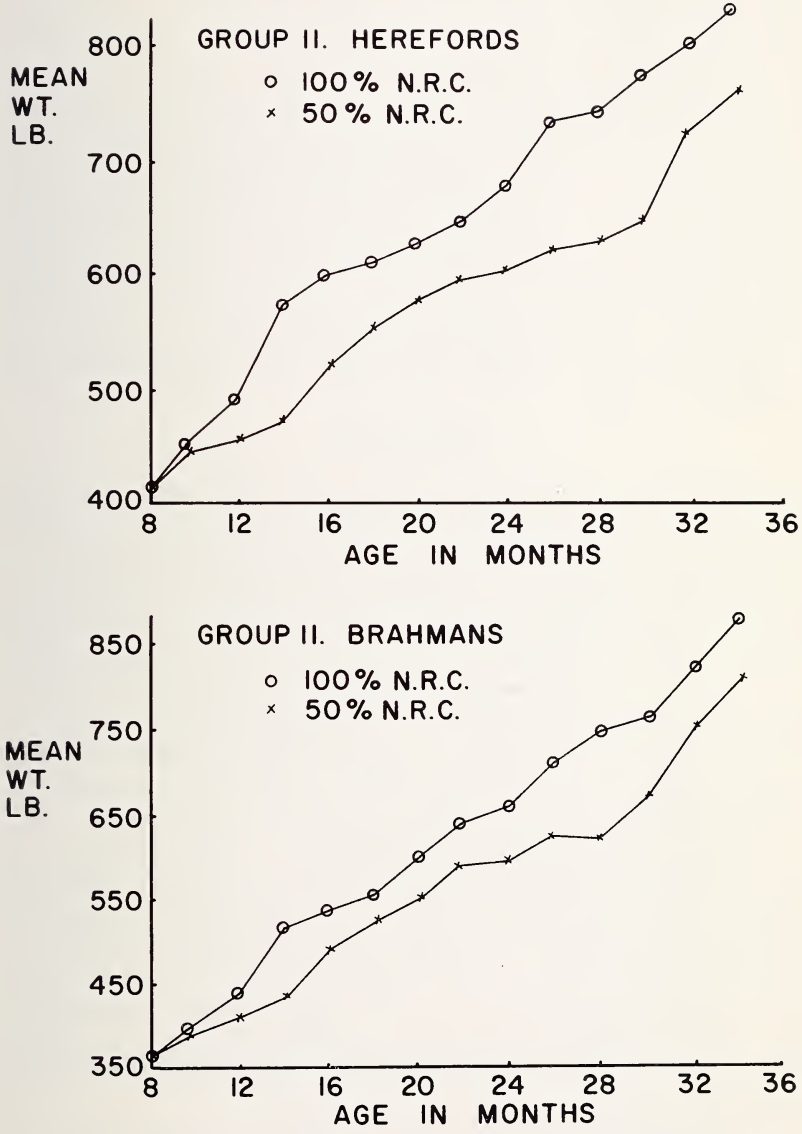

Fig. 3. Growth curves for Herefords and Brahmans in group II.

breeds or diets was evident. An analysis of variance of the gestation length of heifers in Group 3 (Table 4) showed a significantly shorter gestation period ($P < 0.05$) in Herefords. When puberty is estimated by first corpus luteum, Brahmans required an average of 50 days longer to reach puberty on the NRC diet and 63 days longer on the 50% NRC diet (Table 4). Puberty as judged by age at first estrus is to be viewed with apprehension because of the error inherent in visual detection of the first estrus. Although the difference in ages at which the first corpora lutea were detected was non-significant ($P < 0.075$) between diets, the protein restriction delayed puberty in both breeds. Analysis of variance of the breeding to calving interval for Group II (Table 4) showed a significant difference between species and also a species-diet interaction ($P < 0.05$).

Discussion

The accent of this report is upon the growth and reproductive efficiency of Hereford and Brahman cattle maintained in an environment intermediate to those in which these breeds originated. It is therefore appropriate to review the climographs for Gainesville, Florida, Herefordshire, England and the Ongole district of Madras State, India. The Nellore environment was used since the Nellore was one of the predominate breeds in the formation of the American Brahman (Jacobs, 1955). The climograph shown in Figure 5 was constructed by joining in a linear fashion the twelve monthly mean points for temperature as ordinates plotted against the relative humidity as abscissa. Thirty years of data were used.

There were no significant differences in growth rate for the two breeds after weaning and up to 1000 lb. weight. Brahman heifers continued to gain weight up to 1200 lb. whereas Hereford heifers did not attain this weight. As calves, the Brahmans were heaviest in both dietary groups when weaned at 8 months of age. This may be the result of more milk being available to the Brahman calf as reported by Howes *et al.* (1958). The protein restriction slowed growth in Group I and II cows, and in both groups of calves.

Figures 1a and 1b and 4a show the effects of calving and lactation upon the body weight of both species. Herefords in Group I lost weight on both diets and gradually began to gain weight towards the end of lactation. Lactating Brahmans in Group I be-

TABLE 3

Reproduction data, group I

		1st Year	Post Calving Int. Days			2nd Year	
Breed	Diet	Br./Cal. Days[a]	C.I.[b]	Fol.[c]	C.L.[d]	Est.[e]	Br./Cal Days
Hereford	NRC	303 ± 6.78	36.7 ± 3.35	29.8 ± 5.96	56.6 ± 6.17	1.8 ± 0.40	323 ± 4.80
Hereford	50%	313 ± 10.8	33.0 ± 6.89	30.0 ± 7.00	51.2 ± 10.3	0.8 ± 0.30	304 —[f]
Brahman	NRC	319 ± 4.22	35.8 ± 4.22	14.0 —[f]	55.3 ± 7.39	1.0 ± 0.36	346 ± 10.8
Brahman	50%	306 ± 3.39	26.5 ± 1.94	49.0 ± 3.54	65.0 ± 6.69	1.2 ± 0.31	342 —[f]

[a] Interval in days from first observed breeding to calving.
[b] Days after calving to cervical involution.
[c] Days after calving to first large follicle.
[d] Days after calving to first corpora lutea.
[e] Days after calving to first observed estrus.
[f] Too few data to calculate Standard Error.

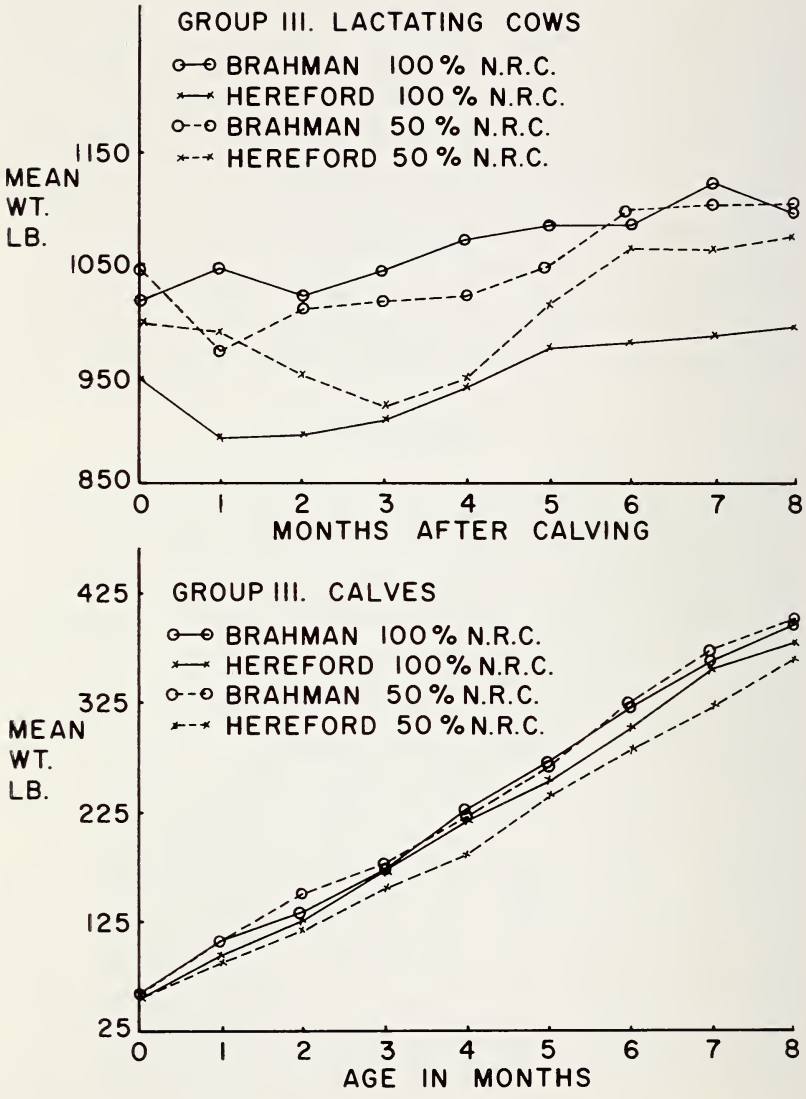

Fig. 4. Live weights of lactating cows in group III and growth curves of their calves.

haved much the same except their loss of weight during lactation was more substantial. This may be the result of their higher milk-in performance (Howes *et al.*, 1958). Lactating Group I Brahmans on the 50% NRC diet lost so much weight that their ability to show estrus and breed was apparently hindered while still lactating. Koger *et al.* (1962) suggested that lactational status was one reason for low fertility in Florida range cattle. The failure to

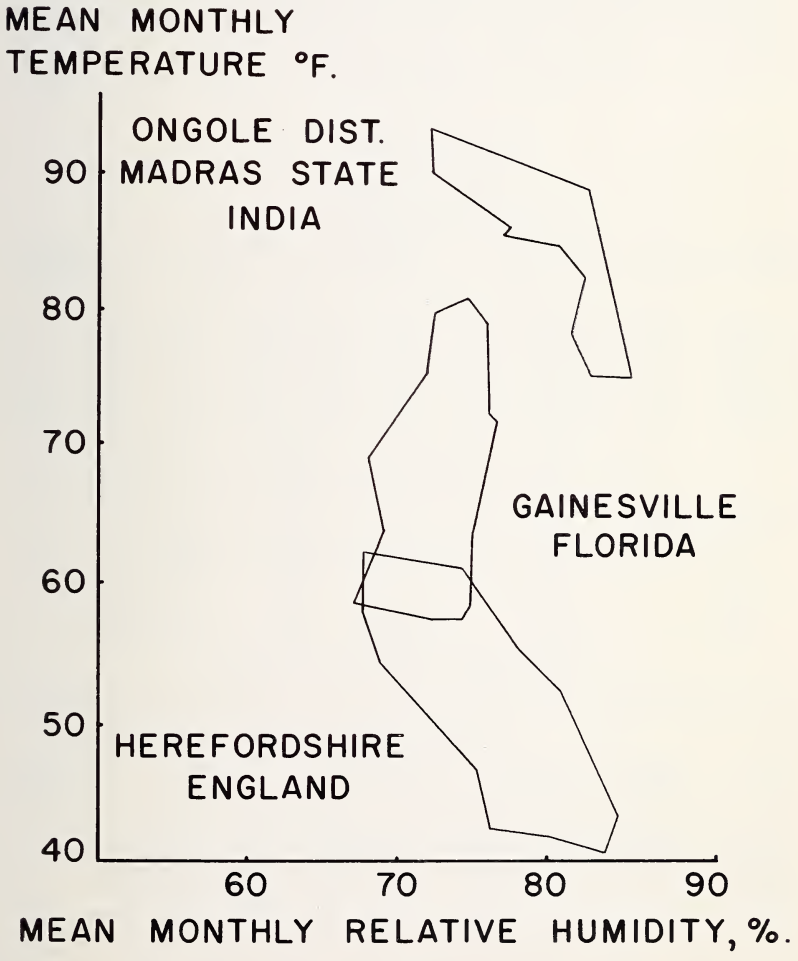

Fig. 5. Climograph for Gainesville, Florida and areas native to Hereford and Nellore cattle.

obtain similar results with the lactating animals in Group III may probably be ascribed to the shorter period that these animals were exposed to the various dietary regimens prior to calving and the lack of an excessive weight loss in these mature cows. They were fed their respective diets only during the latter part of their pregnancy, whereas Group I animals were fed the low protein diet for one year prior to calving.

Breed differences with respect to reproductive performance were the most obvious. Brahmans exhibited very few signs of

TABLE 4

Reproduction data, group II

Breed	Diet	Days for Puberty[a]		BR/Cal., days[b]	Gestation, days
		C.L.	1st Estrus		
Hereford	NRC	408 ± 30.9	436 ± 44.9	296 ± 13.5	278 ± 1.66
Hereford	50%	528 ± 69.8	609 ± 76.7	290 ± 4.74	276 ± 4.07
Brahman	NRC	458 ± 71.3	582 ± 96.2	297 ± 7.71	281 ± 2.66
Brahman	50%	591 ± 79.4	402 ± 34.9	332 ± 14.0	285 ± 3.16

[a] Time in days to reach puberty as measured by first corpora lutea (C.L.) and first estrus.

[b] Interval in days from first observed breeding to calving.

TABLE 5

Reproduction data, for group III*

Breed	Diet	Time in days following parturition to:			
		C.I.	1st Foll.	1st C.L.	1st Estrus
Hereford	NRC	41 ± 5.89	33 ± 9.70	48 ± 6.59	54 ± 14.6
Hereford	50%	38 ± 4.39	44 ± 8.19	65 ± 8.48	57 —[a]
Brahman	NRC	37 ± 4.65	59 ± 12.3	56 ± 9.38	83 —[a]
Brahman	50%	48 ± 15.5	46 ± 5.00	67 ± 11.5	86 —[a]

* Five animals per treatment.

[a] Too few data to calculate Standard Error.

estrus (Table 7); the few estrus periods detected were extremely short (Table 7) and most occurred at night. Brahmans raised fewer calves (Table 6), had significantly longer breeding to calving intervals, took significantly longer to reach puberty, and experienced significantly longer gestation periods. Howes *et al.* (1960) and Warnick *et al.* (1960) have also indicated the lower reproductive efficiency of Brahmans under Florida conditions.

The reduction of dietary protein had serious effects upon reproduction efficiency in both breeds. Most notable was the delay in maturity. The lack of dietary protein may well be a significant cause for the delay in reaching puberty frequently observed in

TABLE 6

Calving percentages

Group	Breed	Diet	No.	1st Calving	2nd Calving
I	Hereford	NRC	6	100	67
	Hereford	50%	6	100	17
	Brahman	NRC	6	67	67
	Brahman	50%	6	67	33
II	Hereford	NRC	6	67	—
	Hereford	50%	6	100	—
	Brahman	NRC	6	67	—
	Brahman	50%	6	67	—
III	Hereford	NRC	5	100	80
	Hereford	50%	5	100	80
	Brahman	NRC	5	100	60
	Brahman	50%	5	100	100

TABLE 7

Duration of estrus in Hereford and Brahman cattle

Breed	Total Estrus Periods	Duration of Estrus Period, Hours 0–2	2–4	4–6	6–8	8–10	10–12	12–14	Over 14
Hereford	31	9	6	5	2	1	0	2	6
Brahman	9	5	3	0	0	0	0	0	1

Florida cattle. The low protein diet restricted subsequent conception in both the Herefords and Brahmans of Group I (Table 6). This may be associated with the lactational status as reported by Koger *et al.* (1962). The only Brahmans receiving the low protein diet which calved the second year were those which were not suckling calves the first year.

Summary

The comparative growth and reproductive performance is reported for three representative groups of purebred Herefords and Brahmans raised on two dietary levels of protein in the same environment. The environment of central Florida is intermediate between the environments in which the Brahman and Hereford breeds originated.

Brahmans weaned the heaviest calves, but the growth rate of Hereford heifers was equivalent to that of Brahmans up to approximately 1000 pounds live weight. Brahmans continued to grow under satisfactory conditions to a heavier live weight. Reduction of the dietary protein by 50 per cent seriously impaired the growth rate of both breeds at all ages. The nutrient allowances as recommended by the NRC (1950) provided the anticipated weight gains for lactating Herefords but not for lactating Brahmans. During lactation, Brahmans on both dietary treatments lost more weight than Herefords, probably because of their better milking performance. Weight losses were so severe on the low protein diets of first calf heifers of both breeds that subsequent reproductive performance was jeopardized.

Brahmans exhibited few visible signs of estrus, and the periods detected were extremely short and mostly nocturnal. Brahmans raised fewer calves, had longer breeding to calving intervals, took significantly longer to reach puberty, and experienced longer gestation periods. The low protein diet significantly delayed the onset of puberty and jeopardized subsequent reproductive performance in both breeds. The impairment of reproductive efficiency in these animals may be directly associated with lactational status. It is concluded from this study that under the conditions prevailing in central Florida Brahman females may have a lower reproductive efficiency than Herefords, but their calves may grow faster up to the time of weaning, probably because of the better milking ability of the Brahman dam. Part of the lower reproduc-

tive efficiency attributed to lactating Brahman cows may be due to an insufficient supply of feed nutrients to meet their relatively higher requirements for superior milk production.

Literature Cited

Cunha, T. J., M. Koger, and A. C. Warnick. 1963. Crossbreeding beef cattle. University of Florida Press, Gainesville, Florida.

Howes, J. R., J. F. Hentges, Jr., A. C. Warnick, and T. J. Cunha. 1958. Yields and composition of milk from Brahman and Hereford heifers fed two levels of protein, and correlated calf growth. Jour. Animal Science, vol. 17, p. 1222.

Howes, J. R., A. C. Warnick, and J. F. Hentges, Jr. 1960. Comparison of different methods for detecting ovulation in cattle. Fertility and Sterility, vol. 11, pp. 508-517.

Jacobs, W. S. 1955. History of Brahman importation. The American Brahman, Oct. 1955, pp. 8-11.

Koger, M., W. L. Reynolds, W. G. Kirk, F. M. Peacock, and A. C. Warnick. 1962. Reproductive performance of crossbred and straight cattle on different pasture programs in Florida. Jour. Animal Science, vol. 21, pp. 14-19.

National Academy of Science. 1950. Recommended nutrient allowances for animals. IV. Recommended nutrient allowances for beef cattle. Nat. Res. Council Pub., No. 579, pp. 1-37.

Rhoad, A. O. 1955. Breeding beef cattle for unfavorable environments. Univ. of Texas Press, Austin, Texas.

Warnick, A. C., J. H. Meade, Jr., and M. Koger. 1960. Factors influencing pregnancy rate in Florida beef cattle. Florida Agr. Exp. Stat. Tech. Bull., No. 623, pp. 1-10.

Department of Animal Science, University of Florida, Gainesville, Florida (present address of senior author: *Auburn University, Auburn, Alabama*). Florida Agricultural Experiment Stations Journal Series No. 1796.